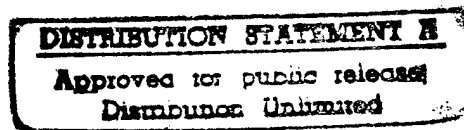


FINAL REPORT
OCTOBER 1996

REPORT NO. 96-50

ENHANCED WOOD PALLET WITH METAL BOTTOM ADAPTER MIL-STD-1660 TESTS

UNCLASSIFIED



Prepared for:
U.S. Army Armament Research, Development
and Engineering Center
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ENHANCED WOOD PALLET WITH METAL BOTTOM ADAPTER MIL-STD-1660 TESTS

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC) to conduct MIL-STD-1660 tests on an enhanced wood pallet with metal bottom adapter. This report contains test results with the pallets provided meeting MIL-STD-1660, Design Criteria for Ammunition Unit Loads, requirements.

B. AUTHORITY. These tests were conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, Illinois.

C. OBJECTIVE. The objective of this test was to confirm that the enhanced wood pallet with modified metal bottom adapter (four corner end braces) meets MIL-STD-1660 performance requirements and is acceptable for use for storage and transportation of ammunition.

D. CONCLUSION. The enhanced wood pallet with modified metal bottom adapter met MIL-STD-1660 requirements.

E. RECOMMENDATION. Recommend this modified metal bottom adapter be approved for use on the enhanced wood pallet with metal bottom adapter.

PART 2

OCTOBER 1996

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PART 3

TEST PROCEDURES

The test procedures outlined in this section were extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is to be considered acceptable. The four tests that were conducted on the test pallets are summarized below.

A. STACKING TEST. The unit load was loaded to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load was simulated by subjecting the unit load to a compression weight equal to an equivalent 16-foot stacking height. The compression load was calculated in the following manner. The unit load weight was divided by the unit load height in inches and multiplied by 192. The resulting number was the equivalent compressive force of a 16-foot-high load.

B. REPETITIVE SHOCK TEST. The repetitive shock test was conducted IAW Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen was placed on, but not fastened to, the platform. With the specimen in one position, the platform was vibrated at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles per second. The frequency was steadily increased until the package left the platform. The resonant frequency was achieved when a 1/16-inch-thick feeler gage momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieved 1 ± 0.1 Gs. Midway into the testing period, the specimen was rotated 90 degrees and the test continued for the duration. Unless failure occurred, the total time of vibration was two hours if the specimen was tested in one position and three hours for more than one position.

C. EDGEWISE ROTATIONAL DROP TEST. This test was conducted using the procedures of Method 5008, Federal Standard 101. The procedure for the edgewise rotational drop test is as follows: The specimen was placed on its skids with one end of the pallet supported on a beam 4-1/2 inches high. The height of the beam was increased if necessary to ensure that there was no support for the skids between the ends of the pallet when dropping took place, but was not high enough to cause the pallet to slide on the supports when the dropped end was raised for the drops. The unsupported end of the pallet was then raised and allowed to fall freely to the concrete, pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection conforms to the following tabulation:

| GROSS WEIGHT (WITHIN RANGE LIMITS) (Pounds) | DIMENSIONS OF ANY EDGE, HEIGHT OR WIDTH (WITHIN RANGE LIMITS) (Inches) | HEIGHT OF DROPS ON EDGES | |
|--|--|-----------------------------|---------------------|
| | | Level A (Inches) | Level B (Inches) |
| 150 - 250 | 60 - 66 | 36 | 27 |
| 250 - 400 | 66 - 72 | 32 | 24 |
| 400 - 600 | 72 - 80 | 28 | 21 |
| 600 - 1,000 | 80 - 95 | 24 | 18 |
| 1,000 - 1,500 | 95 - 114 | 20 | 16 |
| 1,500 - 2,000 | 114 - 144 | 17 | 14 |
| 2,000 - 3,000 | Above 145 - No limit | 15 | 12 |
| Above - 3,000 | | 12 | 9 |

D. INCLINE-IMPACT TEST. This test was conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the incline-impact test is as follows: The specimen was placed on the carriage with the surface or edge to be impacted

projecting at least 2 inches beyond the front end of the carriage. The carriage was brought to a predetermined position on the incline and released. If it was desired to concentrate the impact on any particular position on the container, a 4- by 4-inch timber was attached to the bumper in the desired position before the test. No part of the timber was struck by the carriage. The position of the container on the carriage and the sequence in which surfaces and edges were subjected to impacts was at the option of the testing activity and depends upon the objective of the tests. This test was to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen was subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at time of impact was 7 feet per second.

PART 4

TEST EQUIPMENT

A. Pallet (Test Sample).

- | | |
|------------|--------------|
| 1. Height: | 37.00 inches |
| 2. Width: | 40.75 inches |
| 3. Length: | 44.50 inches |
| 4. Weight: | 1,635pounds |

B. Compression Tester.

- | | |
|-----------------------|----------------------|
| 1. Manufacturer: | Ormond Manufacturing |
| 2. Platform: | 60- by 60-inches |
| 3. Compression Limit: | 50,000 pounds |
| 4. Tension Limit: | 50,000 pounds |

C. Transportation Simulator.

- | | |
|------------------|--------------------|
| 1. Manufacturer: | Gaynes Laboratory |
| 2. Capacity: | 6,000-pound pallet |
| 3. Displacement: | 1/2-inch amplitude |
| 4. Speed: | 50 to 400 rpm |
| 5. Platform: | 5- by 8-foot |

D. Inclined Plane.

- | | |
|------------------|--------------------|
| 1. Manufacturer: | Conbur Incline |
| 2. Type: | Impact Tester |
| 3. Grade: | 10 percent incline |
| 4. Length: | 12-foot |

PART 5

TEST RESULTS

A. STACKING TEST. The test sample was initially loaded to 9,000 pounds compression. The compression was released after one hour. No physical damage was noticed on the test sample.

B. REPETITIVE SHOCK TEST. The duration of the test was 90 minutes for each orientation of the pallet. The transportation simulator was operated at 240 rpm with the pallet oriented in the lateral direction. For the longitudinal orientation, the transportation simulator was operated at 200 rpm. There was no physical damage to the pallet or adapter at the end of this test.

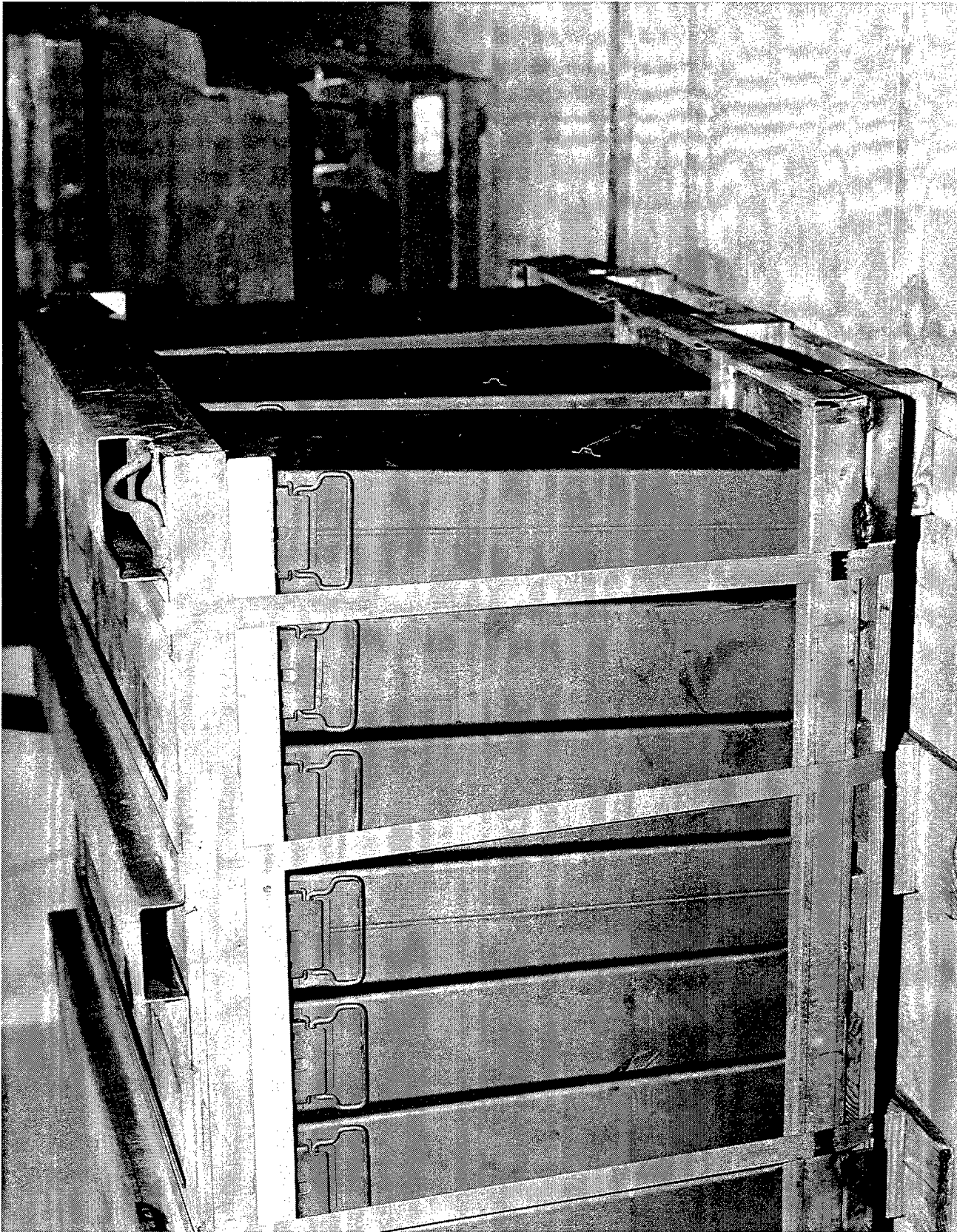
C. EDGEWISE ROTATIONAL DROP TEST. Each side of the pallet was placed on a beam displacing it 4-1/2 inches above the floor. The opposite end of the pallet was raised to a height of 17 inches, then dropped. The process was repeated in a clockwise direction until all four sides of the pallet had been tested. No physical damage was noted during this test.

D. INCLINE-IMPACT TEST. The incline-plane was set to allow the pallet to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact, until all four sides had been tested. No damage was noted during this test.

E. END OF TEST INSPECTION. During final inspection, no physical damage was noticed on either the pallet or the adapter.

PART 6

PHOTOGRAPH



U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL -
SAVANNA, IL

AO317-SCN-96-192-4675. This photo shows the configuration of the palletized unit load.